IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C., United States of America

- - - - - - - - - - - - - - - - - -

UNITED STATES PATENT APPLICATION

for

MODIFIED BOTTLE THREAD DESIGN FOR USE WITH CHILD RESISTANT CAPS

by

MARK BRANSON

and

NARDA JONES

BACKGROUND

The present invention relates to a bottle neck and child resistant closure combination. More particularly, the present invention relates to a modified thread design for use on a bottle neck, in a child resistant closure, or on both the bottle neck and in the closure. The modified thread design provides for the closure to be rapidly displaced in the axial direction relative to the bottle neck. The rapid rise and fall relative to the neck allows a pair of locking lugs on the closure to interact with a pair of locking lugs on the neck only once as the closure is opened or closed. The modified thread design relies on a thread that varies in thickness from the first end to the second end, and the selection of a thread pitch that is greater than the axial height engagement of the bottle lugs multiplied by the number of lugs on the bottle neck.

When properly used, child resistant closures or safety caps are effective in preventing young children from accessing the contents of a bottle. Typically, a bottle is provided with a neck portion having on an exterior surface thereof a thread, having one or more strands, and one or more outwardly-projecting locking lugs, and a closure is provided which is threadingly engageable on the bottle neck portion and which includes one or more inwardly-projecting locking lugs. When the closure is tightly closed, the thread of the closure and of the bottle neck are engaged, and the closure lugs and bottle lugs interlock to prevent the unintended removal of the safety closure from the bottle neck.

Oftentimes, however, the safety caps are not tightly closed – either unintentionally or intentionally – after being opened by the end user. The failure to tightly close the cap may be unintentional, for example, if the user thought the cap was closed and stopped tightening prematurely. On the typical bottle / safety cap combination, as the cap lugs and bottle lugs begin to engage the user may hear a clicking sound or feel the cap "bump". If the user then

fails to continue tightening the cap until the lugs are in the locked position, the cap will not be closed correctly and the safety features will not be properly engaged. The failure to tightly close the cap may also be intentional, for example, if the user believes it is too hard to reopen the cap. To remove the safety cap from the bottle neck, an appropriate force must be applied to the cap, such as squeezing the sides of the cap or pushing downward on the cap, to first disengage the cap lugs from the bottle lugs, and then the cap must be unscrewed to disengage the cap and bottle threads. On the typical bottle / safety cap combination, the user often needs to perform these actions multiple times until the cap lugs rise beyond the reach of the bottle lugs. Because the user may have difficulty re-opening the bottle after the cap is closed, the user may stop tightening the cap before the cap lugs and bottle lugs are engaged. When the safety cap is not properly tightened, its effectiveness is greatly diminished. It is therefore desirable to provide a safety cap and bottle combination that is closed properly when the user first hears or feels the engagement of the cap lugs and the bottle lugs. Further, it is desirable to provide a safety cap and bottle combination that allows for the cap to be removed with nominal effort by the targeted end user.

SUMMARY OF THE INVENTION

The present invention relates to a modified thread design for use with a bottle and child resistant closure combination. The thread may be affixed to the bottle neck on the bottle or to the closure skirt on the closure. The thread varies in thickness from the first end of the thread to the second end, but the thread pitch remains constant as the thread thickness varies. With the pitch held constant, the thickness of the thread affects the rate at which the cap rises or falls along the bottle neck, with the cap rising faster as it moves over the thicker

portion of the thread. In a preferred embodiment, the widths of the thread and the thread pitch are selected to allow the safety closure to rise at a rate that allows cap lugs on the closure to clear bottle lugs on the neck with no more than one revolution of the closure, and falls at a rate that allows the safety features to be engaged when the cap lugs pass over the bottle lugs one time.

The present development overcomes the problems of the prior art by modifying the thread design such that the rate of rise of the safety closure is optimized. These modifications allow the closure to rise and fall relative to the neck such that a pair of locking lugs on the closure interact with a pair of locking lugs on the neck only once as the closure is opened and closed, respectively. Therefore, the user knows the closure is properly tightened when a first click is heard, and the closure can be removed after disengaging the cap lugs from the bottle lugs one time.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a bottle having a thread made in accordance with the present invention;

Figure 2 is a side view of the bottle neck on the bottle of Figure 1;

Figure 3 is a side view of the bottle neck on the bottle of Figure 1 shown rotated 90° from the view of Figure 2;

Figure 4 is a top view of the bottle neck on the bottle of Figure 1;

Figure 5 is a cross-sectional view of the bottle neck of Figure 4 taken along line AA-AA;

Figure 6 is a cross-sectional view of the bottle neck of Figure 3 taken along line F-F;

Figure 7 is a sectional side view of the thinner thread strand segment for the bottle neck on the bottle of Figure 1;

Figure 8 is a sectional side view of the thicker thread strand segment for the bottle neck on the bottle of Figure 1;

Figure 9 is a cross-sectional view of a child resistant closure that can be used with the bottle of Figure 1; and

Figure 10 is a cross-sectional view of a child resistant closure having a thread made in accordance with the present invention.

DETAILED DESCRIPTION

The thread design depicted in the various Figures is selected solely for the purpose of illustrating the invention. Other and different thread designs may utilize the inventive features described herein as well. In the various Figures, the thread design is depicted on a bottle 10 having a neck 14 and locking lugs 28, but the thread design of the present invention and the inventive features described herein may also be used with other child resistant container components, such as different bottle shapes, other containers, closures or caps.

Reference is first made to Figure 1 in which a bottle constructed in accordance with the present invention is generally noted by the character numeral 10. The bottle 10 includes a body 12 and a neck section 14. The body 12 has a bottom 16, and side walls 18 extending from the bottom 16 and tapering into a shoulder section 20. The neck 14 extends vertically from the shoulders 20 and terminates in an opening 24. As shown in Figures 1 through 6, the neck 14 has an exterior face 15 adapted to allow the bottle 10 to receive and engage a complementary closure 50 (such as shown in Figures 9 or 10). The engaging face 15

includes a bottle thread 26, a thread receiving groove 27, and at least one locking lug 28, with the thread 26 and locking lug 28 being fixedly attached to the engaging face 15. Optionally, the neck 14 may include a bottle bead or collar 30. The bottle bead 30 is an annular projection located near the shoulder portion 20 of the bottle 10 and encircling the neck 14.

Figures 9 and 10 show complementary closures 50, 150 which may be used with the bottle 10. The complementary closure 50, 150 can be any threaded closure which will matingly engage the thread 26 and the locking lug 28 of the bottle 10. For example, the closure 50 may be a child resistant cap such as described in U.S. Patent 6,102,223, issued to Montgomery, and incorporated herein by reference. As described in the '223 patent and shown in Figure 9, the closure 50 has a cap top 52, a cap skirt 54 extending from the cap top 52 to a cap bottom 56, at least one cap thread 58 located on an interior surface or engaging face 60 of the cap skirt 54, at least a first cap lug 62 located near the cap bottom 56 and, optionally, a ring guide 64. The thread 58 and locking lug 62 are fixedly attached to the engaging face 60 of the cap skirt 54. The thread 58 of the closure 50 should ride within the groove 27 of the bottle thread 26 while leaving nominal clearance between the bottle thread 26 and the cap thread 58. The reciprocal closure locking lug 62 should be capable of engaging the bottle locking lug 28 such that the closure 50 is prevented from being removed from the bottle 10 without the user deforming the closure 50.

Referring again to Figures 1 – 8, the bottle neck 14 has at least one locking lug 28, having a height "h", which is adapted to engage the cap lug 62. In a preferred embodiment, the locking lug 28 includes a sloped face 28a and an opposing abutment face 28b, and is dimensioned to matingly engage the corresponding cap lug 62. Similar locking lugs are described in U.S. Patent 6,152,315, issued to Montgomery, and incorporated herein by

reference. The bottle locking lug 28 engages the cap lug 62 when the cap 50 is rotated in a clockwise direction. As the cap 50 is rotated, the cap lug 62 passes over the sloped face 28a of the bottle lug 28, distorting the cap skirt 54 in the process. When the cap lug 62 reaches the end of the sloped face 28a, the cap lug 62 can fall against the bottle neck 14 as the cap skirt 54 returns to its resting, non-distorted shape. The user may hear a "click" as the cap lug 62 contacts the neck, or may feel a "bump" as the cap skirt 54 returns to its resting shape. In this closed position, rotation of the cap 50 relative to the bottle 10 is limited, and the cap 50 cannot be removed without the user disengaging the cap lug 62 from the bottle lug 28. To remove the cap 50 from the neck 14, the user must disengage the lugs 28, 62 by distorting the cap skirt 54, for example by squeezing opposite sides of the skirt 54 near the bottom 58, and then rotating the cap 50 in a counterclockwise direction. The cap skirt 54 should be sufficiently distorted to allow the cap lugs 62 to rise to the top 28c of the abutment face 28b. As the cap 50 is then rotated counterclockwise, the cap lug 62 can slide along the sloped face 28a. Concurrently, the cap 50 is lifted or axially displaced relative to the shoulders 20 as the cap thread 58 rides along the thread receiving groove 27 of the bottle 10. Once the cap 50 is axially displaced by at least the bottle lug height "h," the cap lugs 62 avoid being caught or engaged by the bottle lugs 28, and the cap 50 can be removed from the bottle 10 without forcing the user to again disengage the lugs 28, 62. Bottle and cap locking lugs 28, 62 which perform a similar function but which have a different structural design may also be employed in the instant invention.

As shown in Figures 1 – 8, the bottle thread 26 is located on the exterior face 15 of the bottle neck 14. The thread 26 includes one or more strands 26a, 26b as is appropriate for the particular thread configuration. Any of a variety of thread configurations known in the

art, such as a single helix (1 strand), a double helix (2 strands), a triple helix (3 strands), a quad helix (4 strands), or helices with essentially as many strands as may fit on the neck 14 (generically referred to herein as a "multiple helix"), can be employed with the instant invention. The thread 26 circumscribes the neck 14 in a spiral forming the depression or thread receiving groove 27 for receiving the complementary thread 58 of the closure 50. In a preferred embodiment, the thread 26 is a double helix with essentially identical first and second strands 26a, 26b starting on opposite sides of the bottle neck opening 24 and forming intertwining parallel spirals about the bottle neck 14.

The first thread strand 26a has a first or lug segment 40a and a contiguous second or opening segment 44a. As shown in Figure 7, the lug segment 40a has a lug end 34a and defines a first upper edge 41a, a first lower edge 43a, and a first face 42a having a thickness t_1. The opening segment 44a has an opening end 36a and defines a second upper edge 45a, a second lower edge 47a, and a second face 46a having thickness t_2. As is known in the art, the upper edges 41a, 45a, and lower edges 43a, 47a are angled slightly from horizontal allowing the strand 26a to have beveled edges rather than sharp corners at the faces 42a, 46a. In an embodiment, the strand thickness varies such that the thickness t_2 of the opening segment 44a is greater than the thickness t_1 of the lug segment 40a. Because the receiving groove 27 is formed by the strands 26a, 26b of the thread 26, when the strand 26a thickens the relative position of the groove 27 shifts slightly toward the bottle opening 24 and away from the bottle shoulders 20. When the closure 50 is on the bottle neck 14 and the cap thread 58 is engaged in the receiving groove 27, the cap 50 is axially displaced relative to the shoulder 20 more rapidly when the cap thread 58 rides along the thickened segment of the strand 44a than along the thinner segment of the strand 40a.

In an alternative embodiment, the strand thickness varies such that the thickness t_1 of the lug segment 40a is greater than the thickness t_2 of the opening segment 44a. The thinner strands near the opening provide a relatively wide thread receiving groove 27 so it is easier to engage the closure thread 58 to the bottle thread 26. Similar to the strands having a thicker opening segment than lug segment, along the thickened strand, the cap 50 is lifted slightly as the cap thread 58 moves through the groove 27, thus causing the cap 50 to be axially displaced relative to the bottle shoulders 20 faster than would be observed with thinner bottle thread 26. In another variation, the thickening of the strand 26a may be gradual, rather than distinctly segmented. For example, the strand 26a may start at the lug end 34a with a face thickness t_1 and gradually widen to a face thickness t_2 near the opening end 36a; or, the strand 26a may start at the lug end 34a with a face thickness t_2 and gradually narrow to a face thickness t_1 near the opening end 36a.

In a preferred embodiment, the thickness t_2 of the opening segment is greater than the thickness t_1 of the lug segment, and the lug segment 40a makes about one-half turn before the strand 26a thickens into the opening segment 44a. In a more preferred embodiment, the strand 26a makes one turn about the neck 14 and thickens at about its midpoint. In a most preferred embodiment, the strand 26a thickens about one-half turn from the lug end 34a and has a thickness t_2 near the opening end 36a that is essentially at least double the thickness t_1 near the lug end 34a, and the upper edges 41a, 45a and lower edges 43a, 47a are angled relative to the horizontal plane "x". For example, in an embodiment, the lug segment 40a has an upper edge 41a angled at about 30°, a lower edge 43a angled at about 7°, a face thickness t_1 of about 0.025 inches, and the segment lug 40a makes about one-half turn before flaring

into the opening segment 44a which has an upper edge 45a angled at about 30°, a lower edge 47a angled at about 7°, and a face thickness t_2 of about 0.056 inches.

Each strand 26a, 26b of the bottle thread 26 is spiraled around the neck 14 at a predetermined thread pitch, or the axial distance from any point on the helix of the strand to the corresponding point on an adjacent turn of the helix. The pitch can be defined by the reciprocal of the number of turns per axial displacement inch (*i.e.* dividing the number one by the number of turns per axial displacement inch) and results in a predetermined rise of the closure 50 per revolution. In order for the closure 50 to function as intended, that is, for the cap lugs 62 to clear the bottle lugs 28 after being released by the user only one time, the pitch must be greater than the bottle lug axial height engagement multiplied by the number of bottle lugs. (The "bottle lug axial height engagement" refers to that height of the bottle lug which interacts with the cap lug. Although the axial height engagement will typically be essentially equal to the bottle lug axial height, embodiments may be envisioned in which the bottle lug axial height "h" differs from the axial height engagement. Alternatively, the closure lug height may vary such that the axial height engagement differs from the closure lug height.) For example, in a preferred embodiment, a bottle neck has two diametrically opposed lugs each having an axial height "h" of about 0.123 inches and an axial height engagement of about 0.123 inches, and each strand 26a, 26b of a double helix makes one turn about the neck at a pitch of about 0.250 inches or an axial displacement distance slightly greater than the axial height engagement of the lugs multiplied by the number of lugs (0.123" x 2 = 0.246").

The thread thickness t_1, t_2 combined with the thread pitch determines the rate at which the cap 50 rises relative to the bottle shoulders 20 as it 50 is being removed from the bottle

neck 14. The thicker the strands 26a, 26b and the steeper the pitch, the faster the cap 50 rises. Preferably, the pitch and thread strand thicknesses are selected such that the locking lugs 62 on the closure interact with the bottle lugs 28 only once as the closure 50 is opened or closed.

As shown in Figure 10, the modified thread design 158 may be incorporated in a closure 150 in place of the standard thread 58 of the closure 50. Similar to the thread designs presented for use on the bottle neck 14, the closure 150 may include a thread 158 having a variety of thread configurations, such as single helix, double helix, triple helix, quad helix, or helices with essentially as many strands as may fit on the closure skirt 154. Depending on the thread configuration, the thread 158 may have one or more strands 158a essentially identical to the first bottle thread strand 126a. As with the bottle thread strand 126a, the closure thread strand 158a may have a first thickness near the cap top 152 and a second thickness near the cap bottom 156. Similar to the thread designs described for the bottle neck 14, the first thickness may be greater than the second thickness, or the second thickness may be greater than the first thickness. The strand 158a may have distinct segments with first and second thicknesses, or as shown in Figure 10, the strand may gradually transition from a first to a second thickness. The pitch is preferably selected such that the cap lugs 62 clear the bottle lugs 28 after one revolution. The closure 150 with the modified thread design may be used with a bottle having a standard thread, or with the bottle 10 having a thread 26 modified as described herein.

Thus, by using a thread 26 with a thickened section and that has a pitch which is slightly greater than the axial height engagement of the locking lugs multiplied by the number of locking lugs present, the instant invention provides the user with a child resistant

closure and complementary bottle that engages the safety features with nominal effort when tightening and that allows the cap to be removed with only slight exertion by the user. Because the cap lugs 62 only interact with the bottle lugs 28 when the cap 50 is in the fully closed position, the user knows the cap 50 is properly tightened when a first click is heard. Because the cap lugs 62 are axially displaced from the bottle lugs 28 within one revolution of the cap 50, the cap 50 can be easily removed after disengaging the cap lugs 62 from the bottle lugs 28 one time.

From a reading of the above, one with ordinary skill in the art should be able to devise variations to the inventive features. For example, other thread configurations are known in this industry and could be employed with the instant invention, and the cap and bottle would employ matching thread configurations. Further, the bottle bead may be more or less tapered, or alternative configurations of bottle and cap locking lugs may be used. These and other variations are believed to fall within the spirit and scope of the attached claims.